Scratch Built: Double Farilie

BY
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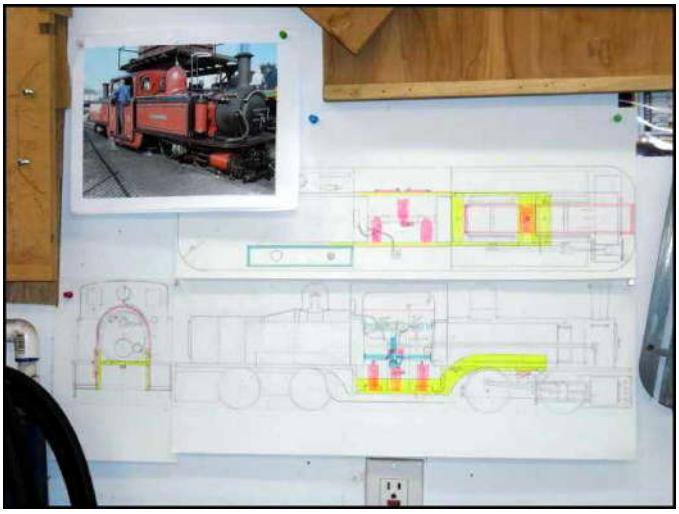
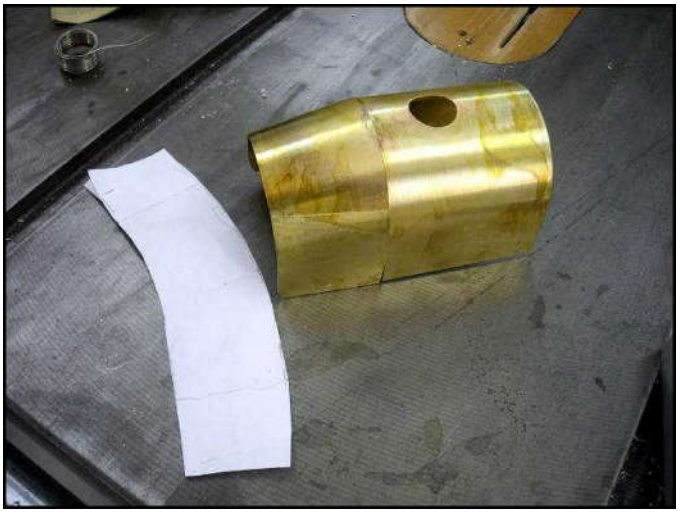
(Live Steam Forum/Topic: Double Fairlie Construction)
(Live Steam Forum/Topic: Double Fairlie Completed)
(Live Steam Forum/Topic: Double Fairlie Video)

August 25th I started construction on a 1:16 scale G gauge Double Fairlie. So far I have the center section about 75% completed. My friend Dennis Mead is drawing up the running gear and we should be ready to start on it in a week or so. I am posting some pictures in response to a question by someone in another thread. I will continue to post pictures and try to answer questions about the construction as I go along.



In answer to a question posed by Pete Thornton, yes it is 1:16 or 3/4 scale. The original runs on a 2' (1' - 11.5" actually) Gauge track. This scales out to 1:13.3 for 45mm track and 1:19 for 32mm track.

As most of the models are done in the UK on 32mm track, I guess 1:19 would be the more popular. When I scaled it out, the size seemed too toy like to me on our G scale layouts. I did a scale drawing in 1:13.3 and it was too big. So I decided on 1:16 as a good compromise and am very happy with the size and the look. My goal is to have a one-of-a-kind locomotive as close in overall look as the original as I can. The scale will add to its uniqueness. The only drawback is that I will also need to make my own cars for it.

David Bailey, DJB Model Engineering Ltd.

"Having built several Double Fairlies at 16mm scale I compliment you on your effort, I must admit that getting working Stephenson valve Gear in between the frames was a challenge, but having worked on the full size engines I can vouch for the lack of space when oiling up."

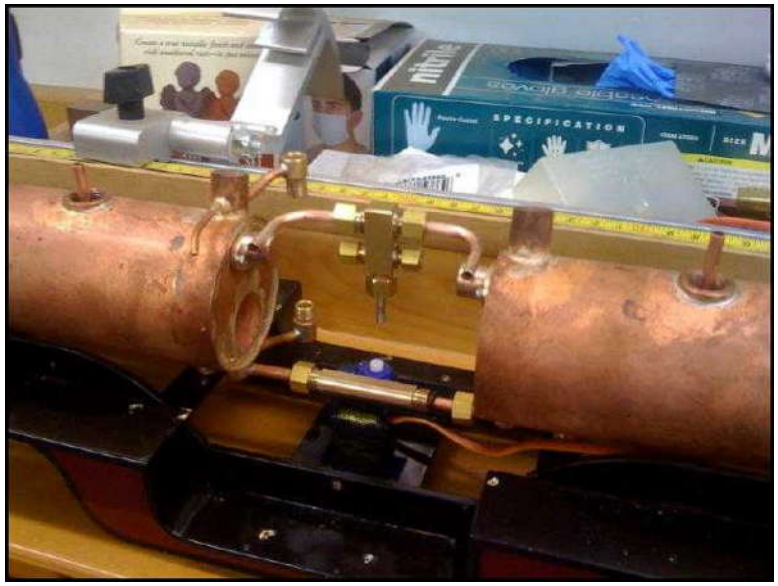
"My model engines were gas fired and to scale, I tried several different types of boiler, one with two burners, one with one Ceramic burner and one with Meths firing, the biggest problem is that on Merddin Emrhys the side tanks are very small so I had two gas tanks, if I ever built any more I would change the design to use new ideas that I have."

In response to David's comments above; the close quarters is one if the things that steered me toward the larger scale. I plan on having two gas-fired boilers with the valving and servos enclosed in a faux firebox. I want a throttle regulator; whistle valve, and possibly a boiler vent valve all with RC. In addition to this, I will have a servo at each engine for reverse and maybe a servo for the cylinder drains.

We have it on CAD but making everything fit may be a horse of a different color. My tanks are about 1" X 1.9" X 5". I will be using two for water, one for RC equipment and one for gas. The gas tank will be slightly smaller to allow for the outer cover with the rivet detail.

I was also wondering if you know about the outside pumps on the original. The photo I have looks like there are two central oilers driven by what would normally be a valve timing crank and on the other side there is something that looks like a hydraulic pump. I am still trying to figure out how to fit the feed water pump in and that may be a way to incorporate two low volume pumps into the system.

I would love to see a shot of your work David, and any ideas you may have for this project.



Here are some shots on the progress. In the first shot, you can see how the throttle will work. Dry steam is drawn from the steam domes on both boilers and directed to the throttle valve mounted in place. The two smaller fittings will attach to "S" shaped tubes which will be silver soldered to the SS super-heater tubs which will run through the burner flues. You can just see the blue servo directly below the valve, which will work the throttle. The two open tubes on the other side of the valve will have 1/8" copper tubes soft soldered in for whistles and other accessories. The long connector at the bottom will be drilled out to hook up the clack valve (still in design)

The next shot shows the firebox cover and the site glass and pressure gauge. These will be the only visible connections, as everything else will be covered by the firebox. This side of the firebox has riveted plates over the door openings and the other side has two faux doors.

This final shot approximates the final look. The two front tanks are water tight and plumbed for feed water. The rear tank will be used for RC equipment. The other tank, which isn't finished, will be for butane. Still need to add the exhaust stacks, Steam dome/ pop off valve and cover assembly, and what I think were sand tanks which will be used by me for dead leg lubricators and go in front of each side tank.

David Bailey, DJB Model Engineering Ltd.

"There are no pumps on the Double Fairlies, only two injectors below the centre footplate, the mechanical lubricators are a later addition added in preservation days, the original engines had hydrostatic lubricators in the cab."

Thanks David.

David Leech, Delta, Canada

"This looks like quite the project and the brass work looks great. Why not just have one long boiler, but with a central burner and flues going both front and back? Just a thought!"

I thought of doing a central burner and even doing a coal fired one but I think both would be too complex for me as this is only my second project. I may have to put these in and then go back and edit them to get them to work.

David Leech, Delta, Canada

"I am assuming that the steam from both boilers just enters into the valve, and then the throttle spindle is below this point. Okay, now IF you have steam from boiler A at say 50 psi, and boiler B at say 40 psi, when the steam enters the turret will the steam pressure from A actually STOP the steam from B from entering the turret?

"I have no idea what happens when you try to combine steam from two sources that may NOT be at the same pressure! I guess that you will find out. It may be that you will in reality only be using the steam from one boiler. Anyway, the painted body looks great."

"I have just looked at the photos again and realised that you have the boilers connected by a pipe at the bottom, so that will equalise the pressures, I think!"

The throttle valve is also a "T". There is a 5/32 hole drilled through the block, which should equalize the pressure, water level, and to some extent the temp. With the top and bottom connection tubes, we should have something very close to one boiler. The tube sticking out of the top of the boilers is part of the steam pickup at the backhead. These will be covered with a steam dome, which will have a pop-off valve on top. Using a pop-off on each boiler should prevent uneven pressures and let me know if one boiler is building more steam than the other. I plan on using the same butane burners as I did on the Garrett. They work well and seem to burn evenly. I will use only one butane valve but leave room to add a second if needed to equalize the temp.

Bob Sorenson, Las Vegas, Nevada

"How did you do the pin stripe?"

"When you say "central burner" do you mean one gas jet, one mixer chamber and then branching to two burner tubes? That should be OK. If you go with two separate burners, I would suggest a separate valve for each. If there is any difference between the jets, the gas could follow a path of least resistance. One burner is just right and the other starved. A lot of Accucraft K's have trouble keeping both burners lit. I think that's the problem."

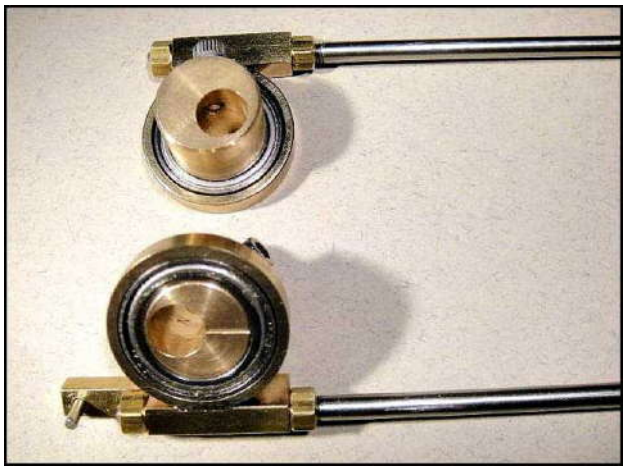
Bob: The pin striping was easier than you would think. I got some 3M 1/16" automotive striping tape on line - #70102.

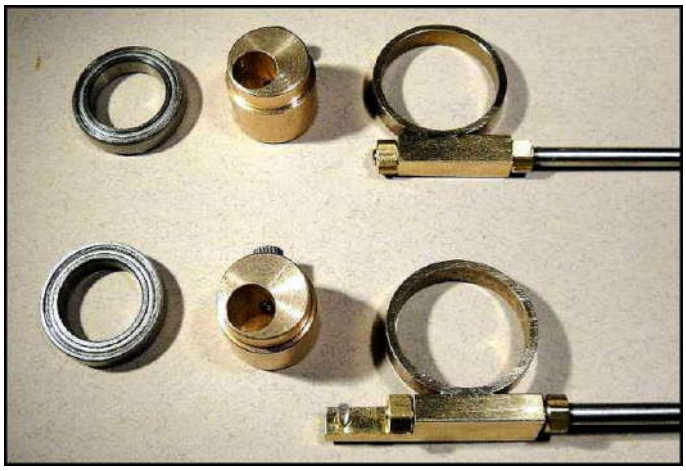
I have two different size rectangles. I took blue masking tape and cut it to the dimensions of the inside of the pin striping. I then cut out the corners of the tape to where I wanted to start and stop. I then laid the striping tape next to the edge of the masking tape with an inch or so overlap at the start. Then with a new razor blade, I cut the start and finish points by holding the blade in the tape and pulling up on the overhang. The little reverse radii were done with a #1 lettering brush after the masking tape was removed. That part of the job is a little shaky but the original was hand painted so I guess it wasn't perfect either.

The central burner we were thinking of was either a coal fired one or more likely a butane one with a ceramic burner and two tubes or possibly an alcohol set up. The reason I am going with two burners is that it is simpler and allows more room for steam valves and servos. I will have three servos in the firebox area and four if there is room. I know about the K problems but I believe that was a production problem. My last project was a Garrett and we made our own burners and jets and both burners seem to perform fine. That being said, I plan on leaving room to add a valve should one burner burn hotter than the other and it can't be corrected by changing jets.

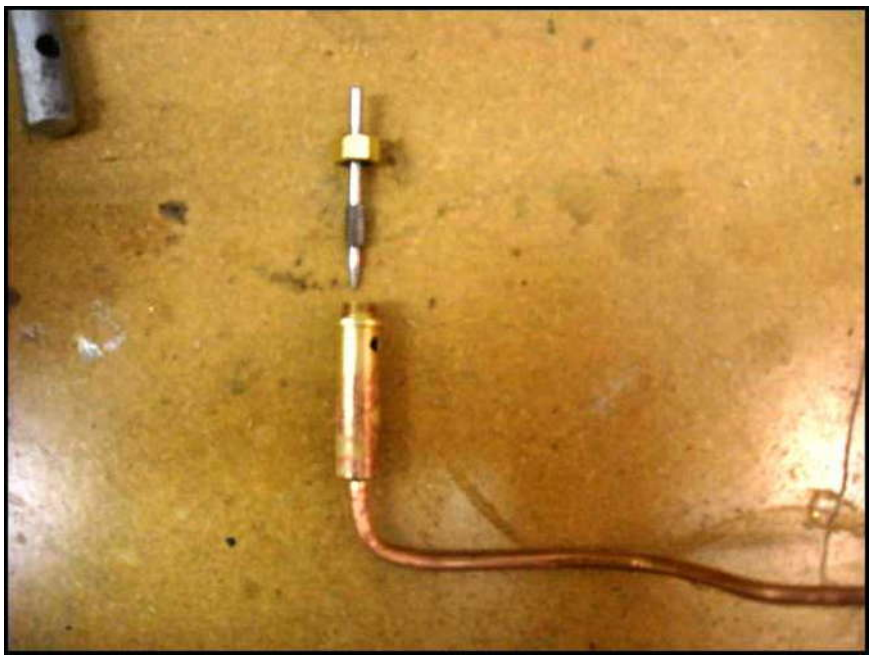
Progress report:

I have been contemplating ball bearing eccentrics for a while. I found these skate board bearings that fit the bill. They are 12x18x4 mm and they were $29 for ten on ebay. You can by them individually for about $4 each. As you can see from the photo the bottom eccentric has an additional connector, which may be used for an axle pump. In addition to the reduced friction, these sealed bearings should last a lifetime without lubrication.

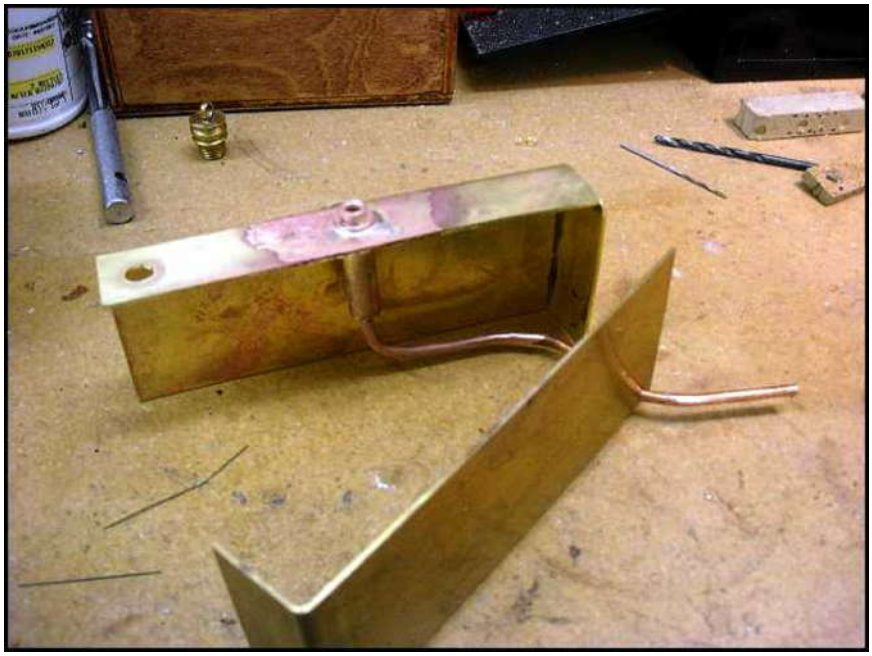




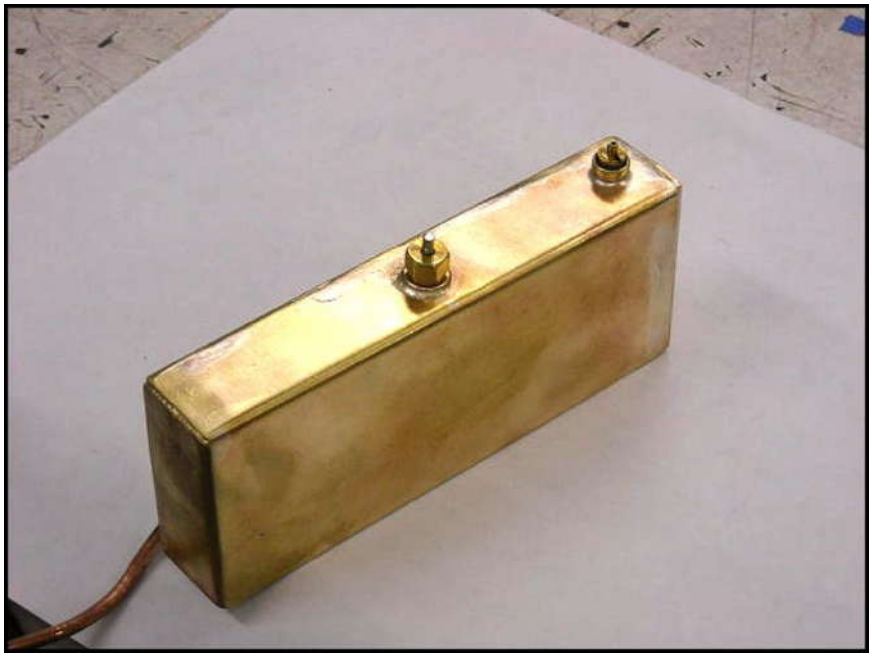
Here are two eccentrics assembled (above left picture), one front and the other rear. Only one eccentric will power the axle pump the other three are for valve timing.



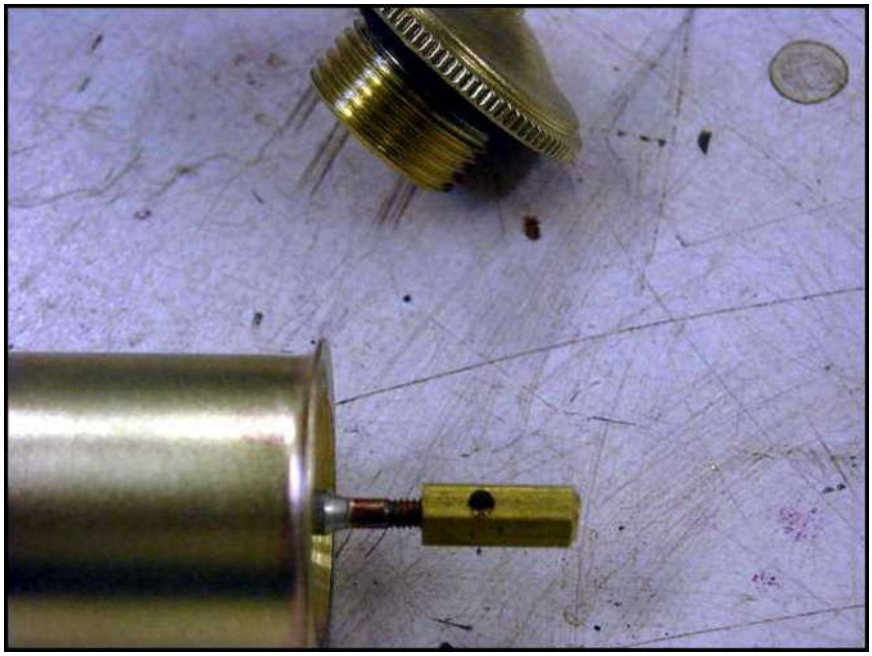
This is the butane valve that is in the tank. The gas goes in the hole at the top and out the tube in the bottom. It's hard to see here but the threads on the needle valve are ground off on the sides to allow the gas to pass through.



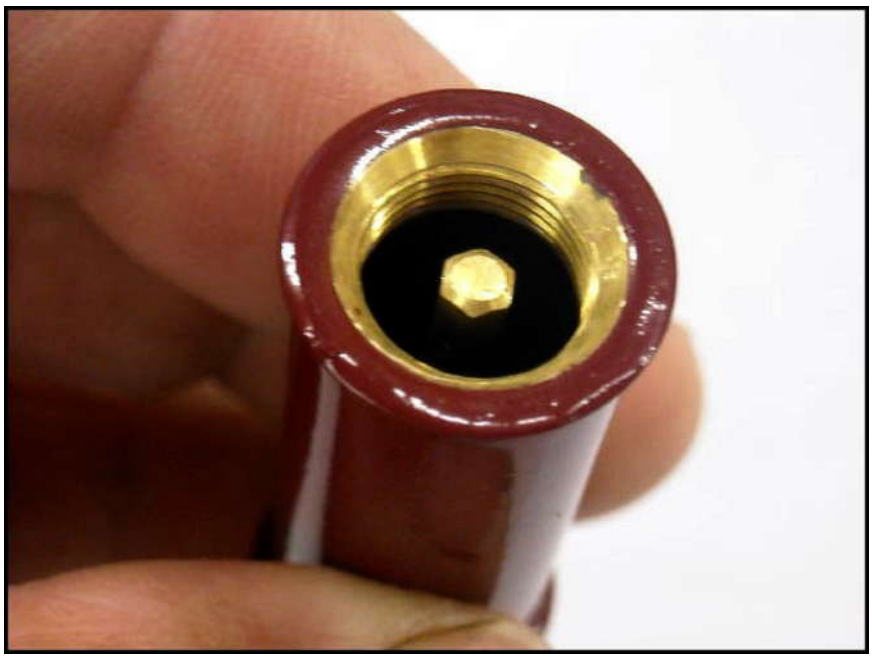
Here are the two components of the tank ready to be silver soldered together. The material is .040" brass, which was bent at 45 on two adjacent sides. Soldering was done similar to boiler soldering and the finished job was pressure checked at 100 psi.



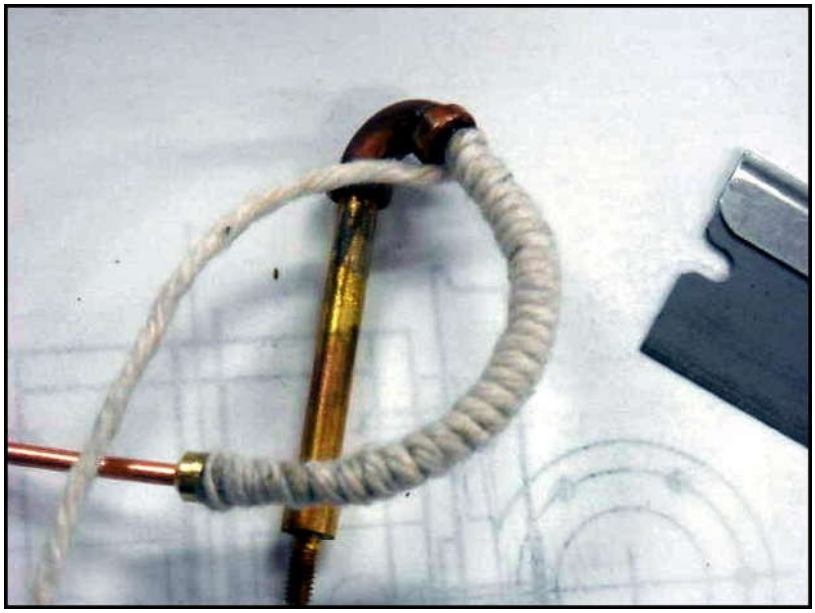
Finished tank will be covered with a rivet detail shell matching the water tanks. This doesn't show it but there is a well nut braised on the bottom for mounting.



There are four tanks on the front corners of the Fairlie which I think are for sand. I am using two for dead leg lubricators. Here is a shot of the valve I made. It is just a piece of 1/16" copper tube threaded to #0-80 and capped off with a piece of 1/8" hex drilled and tapped with an escape hole drilled sideways at the bottom of the hole. I have a C-16 which I have done the Hottman conversion to which uses 1/16" tubing and it runs a little too wet for me. I am thinking I will end up throttling it down about 50%. I made the threads very tight by not going all the way taping the cap. This should prevent it from backing off.

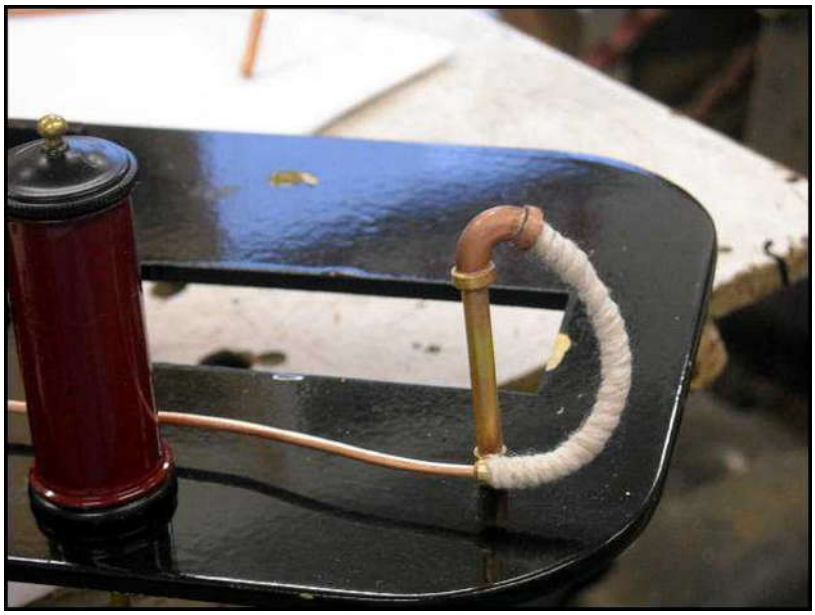


The tube and valve are now soldered in place. The 1/8" hex can be adjusted with a #2-56 nut driver.

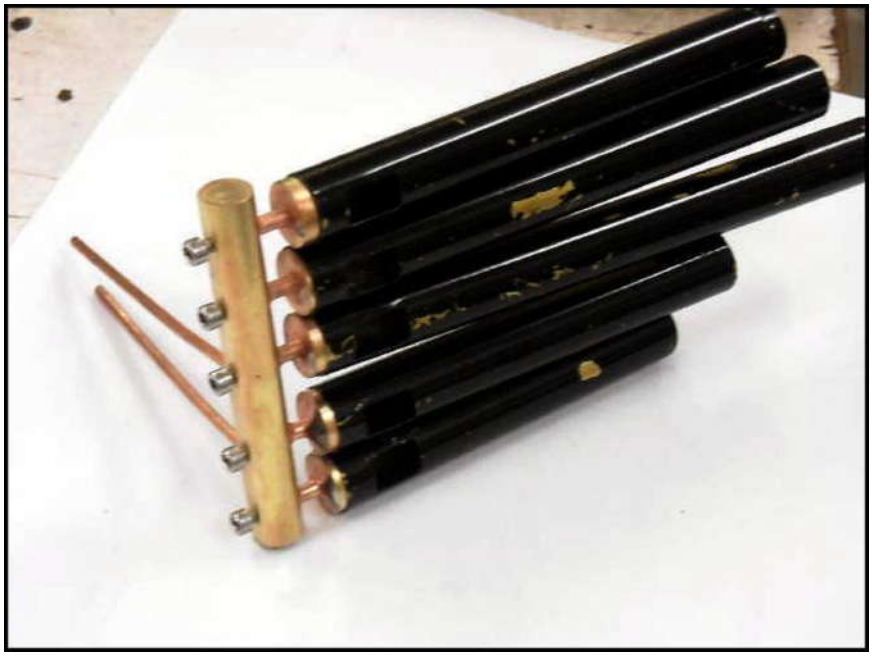


The double Fairlie has what I think is a vacuum brake pipe which looks a lot like the one on the Round House single Fairlie. I was thinking about getting two from them but my scale is a little different and I didn't want to wait for delivery across the pond. Besides, this was more fun.

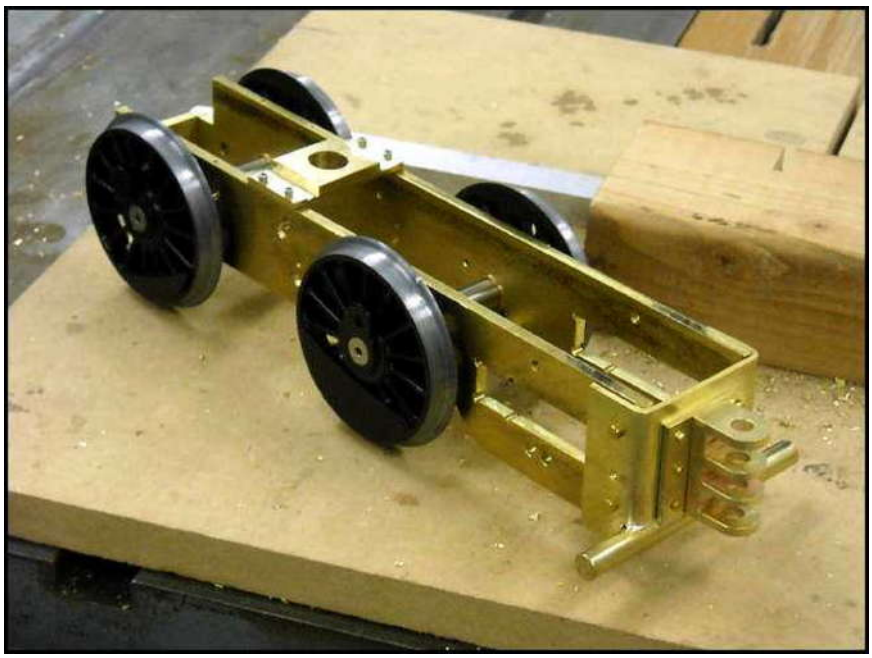
I go to Home Depot from time to time and get copper ground wire from the bulk rolls. I try to keep gauges 14 - 8 in my shop. I buy 3' lengths and ask them not to coil it as it comes off the large spool with no kinks. This material bends better than anything I have found and is what I used for the fitting at the top. The prototype has this very acute bend, which could only be done with this wire. I think this was 8 ga. but I just selected the one, which looked the best. After it was bent, I cut it to length and drilled holes in the ends to hold the pieces in alignment during soldering. The raised ends were turned out of brass. The standpipe is 1/8" brass rod. The lower base was turned out of brass and threaded to #2-56 on one end and drilled to 1/8" for alignment. The core of the bent pipe is 14 ga. copper wire and the wrap is string.



Here is the pipe and lubricator in place.



The Fairlie will have two sets of whistles The two tone will have I high pitch British sound and the three tone one more American. Blown together, they have a five-whistle tone that is very distinctive. Note the SS screws, which have been turned to needle valve. These are used to adjust the steam volume, which gives it maximum volume without over-blowing. You can see from the scratched paint, this was not a total success the first time around. I have tuned them with air pressure at 60 PSI but they may sound different under steam.



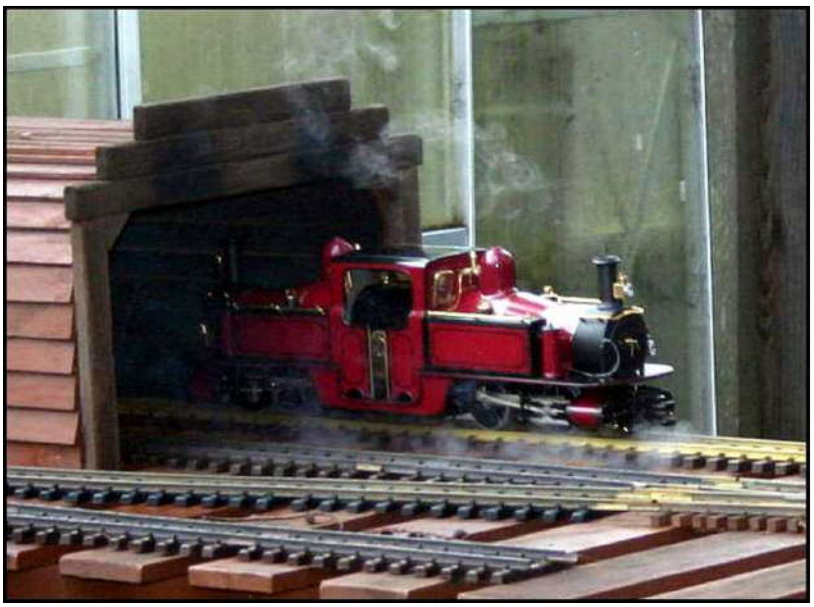
Here is one of the chassis frames. Bare bones at this time...More to follow

After four months, the Double Fairlie is complete and running.

Pictured above it is building up steam for a morning run.

After clearing out some moisture through the cylinder drains, she is on her way.

My Garden Railroad structures provide a nice backdrop.



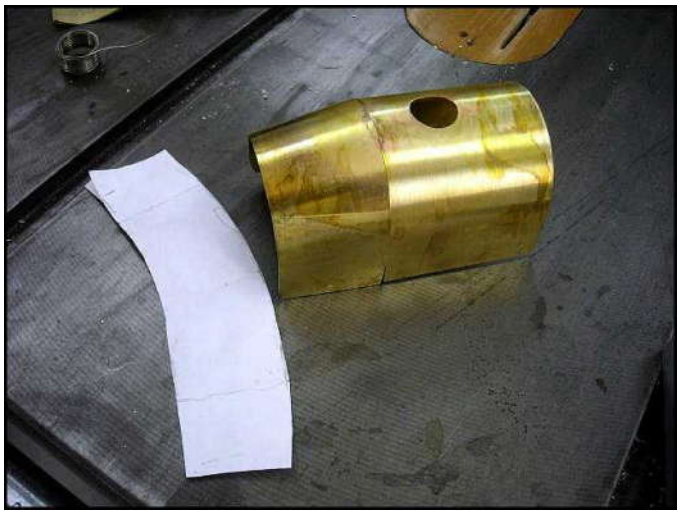
Pulling out of the tunnel.

Here are the specifications:

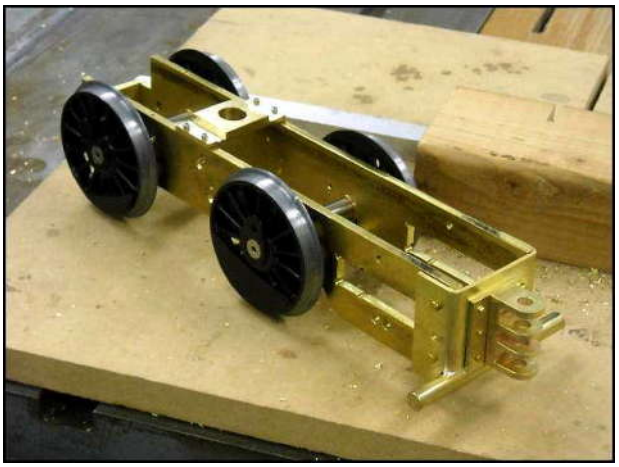
- 1:16 scale.
- 45mm Gauge.
- Scratch built except wheels and knobs in firebox.
- 1/2" cylinders.
- Modified Stephenson valving.
- Two-tone and three-tone whistles each servo actuated.
- Ball bearing eccentrics with feed water pump driven off one eccentric.
- Two pop off valves.
- Two boilers with wagon top insulated wraps.
- Butane fired with two burners.
- Four re-positionable headlight lanterns.
- Working cab windows.
- Hand formed stacks and dome covers.
- Two water tanks, one tank for butane, and one houses the RC equipment.
- Five RC circuits, seven servos.

Here are some construction photos:

Mainframe platform.

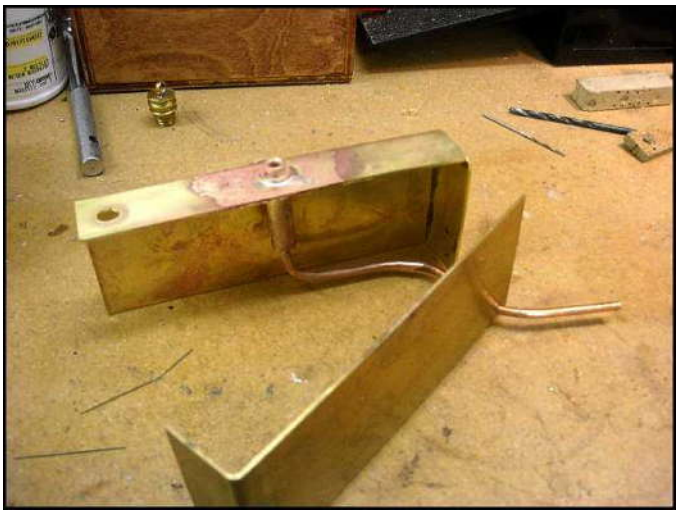


Silver soldered boiler cover.

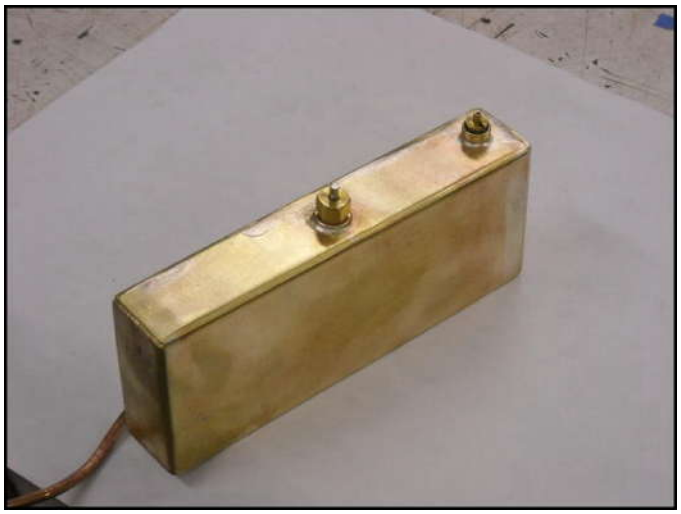


Bogie frame.

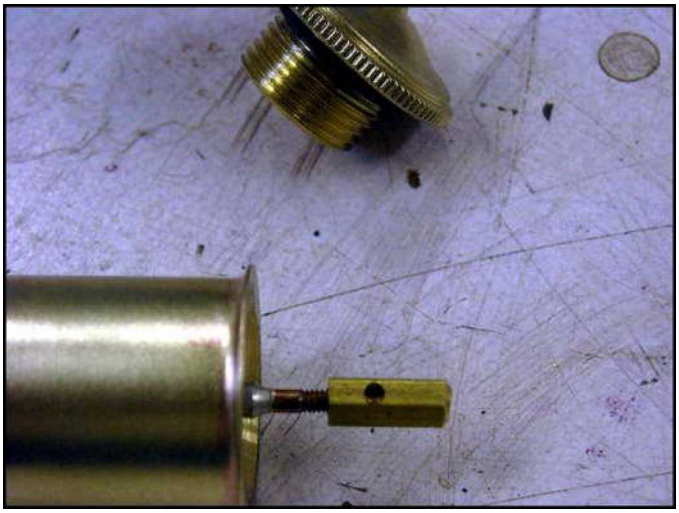
Skate board bearings for valve eccentrics. Bottom one is for driving the water pump also.



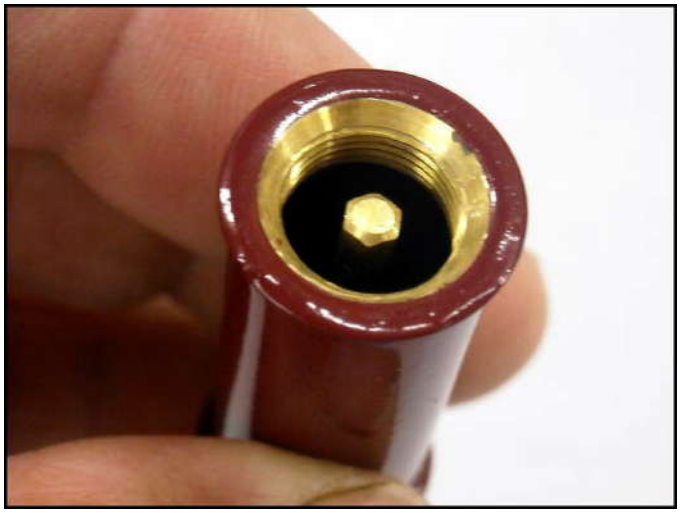
Butane tank ready to solder.



Butane tank.

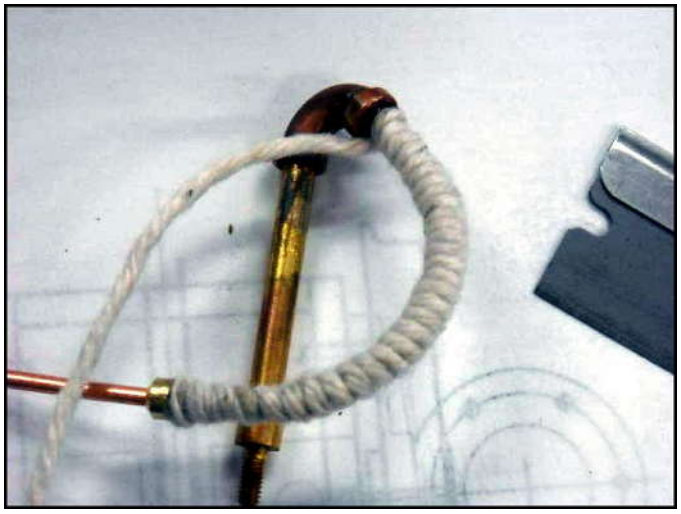


Lubricator adjustable cap.



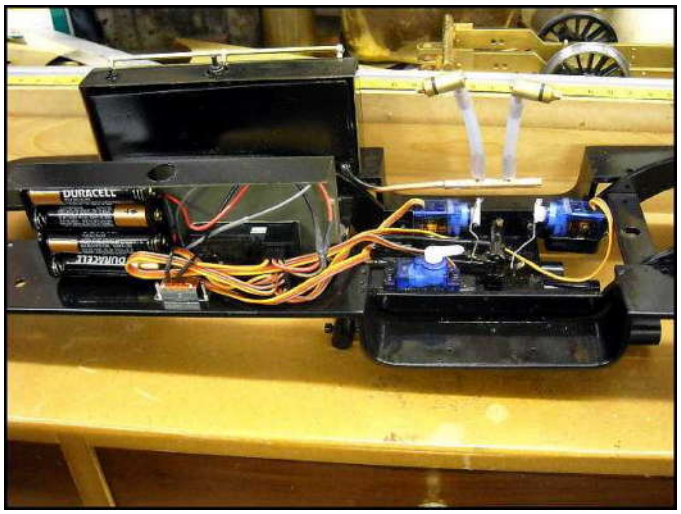
Adjustment cap soldered in place.

Underside view.

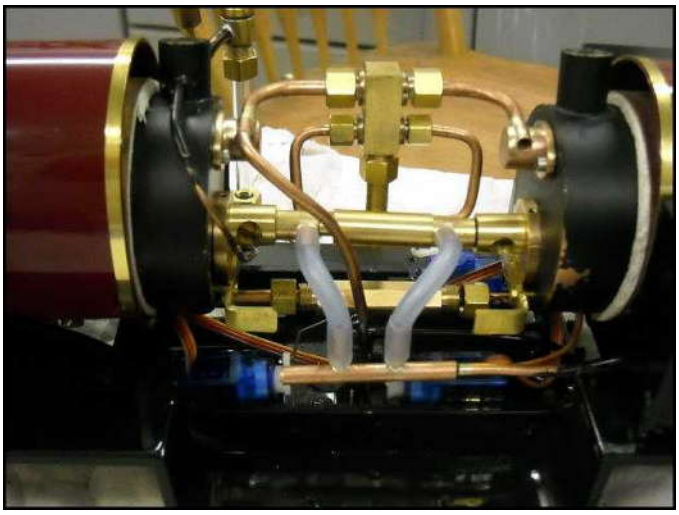


Vacuum hose detail.

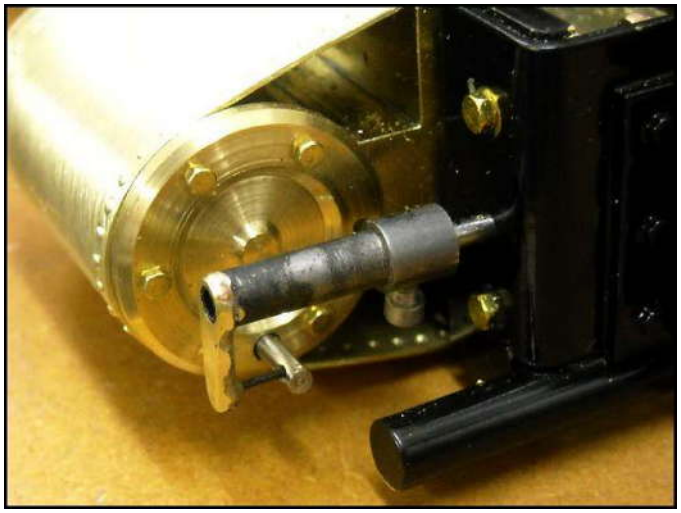
Whistles.



Two servos in the back are for the two-outlet whistle valve- hard to see because they are black, front servo is for throttle.

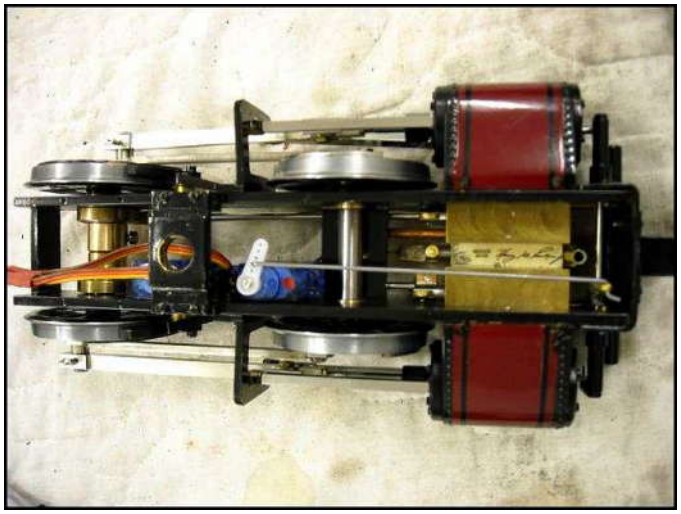


This is an early shot of the fittings. Some have been added since then.

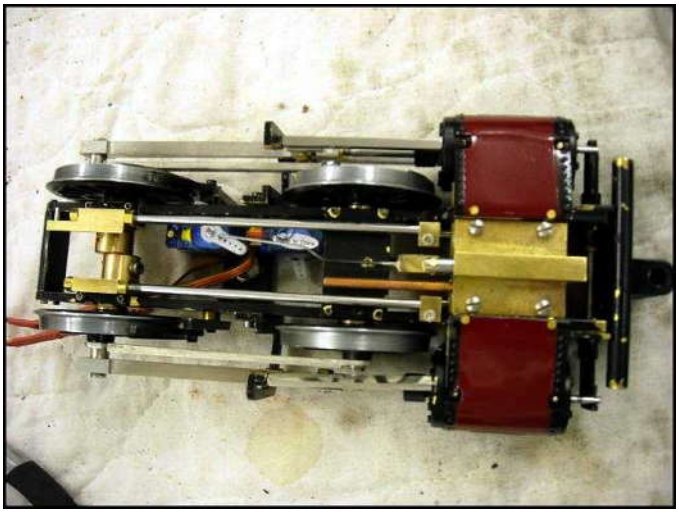


Early shot of cylinder drains and link to RC servo.

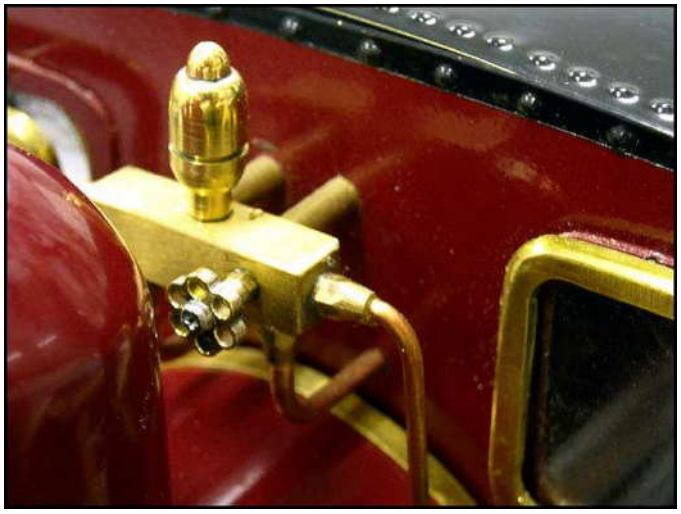
Home made Johnson bar and Trackside Details knobs.



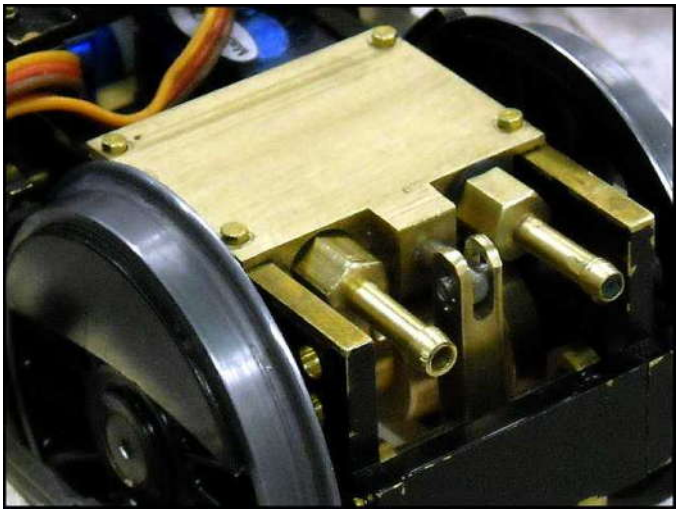
Cylinder drain servos looking from the top of bogie.



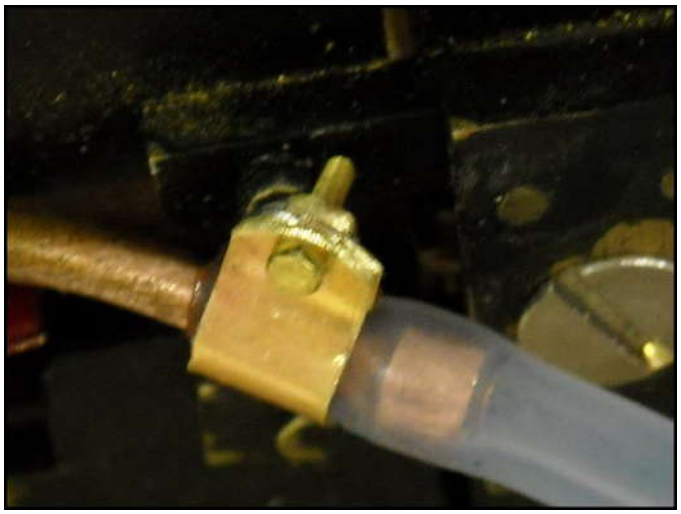
Reverser servo looking from bottom of bogie.



Cab detail per original. Knob made by Dennis Mead 1/16' brass tubing soldered together and then cut to length - 1/16".



Feed water pump driven by valve eccentric through rocker lever mounted to frame.



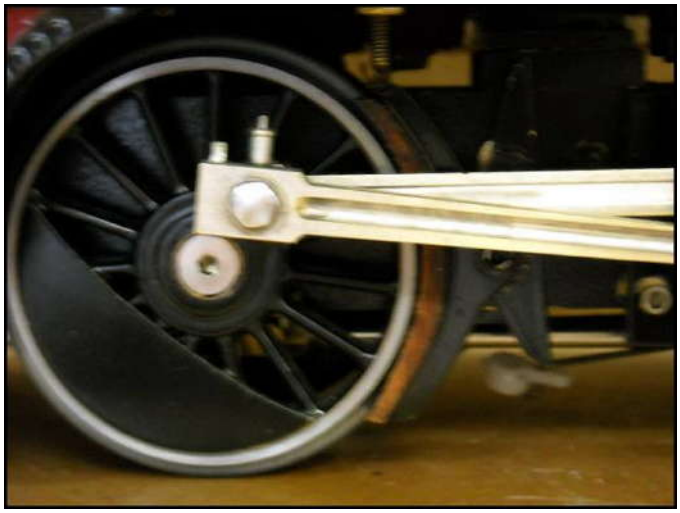
These home made clamps were the only things that worked well on the articulation points. The exhaust is all metal at the pivot per the original.

Working windows.

Lantern

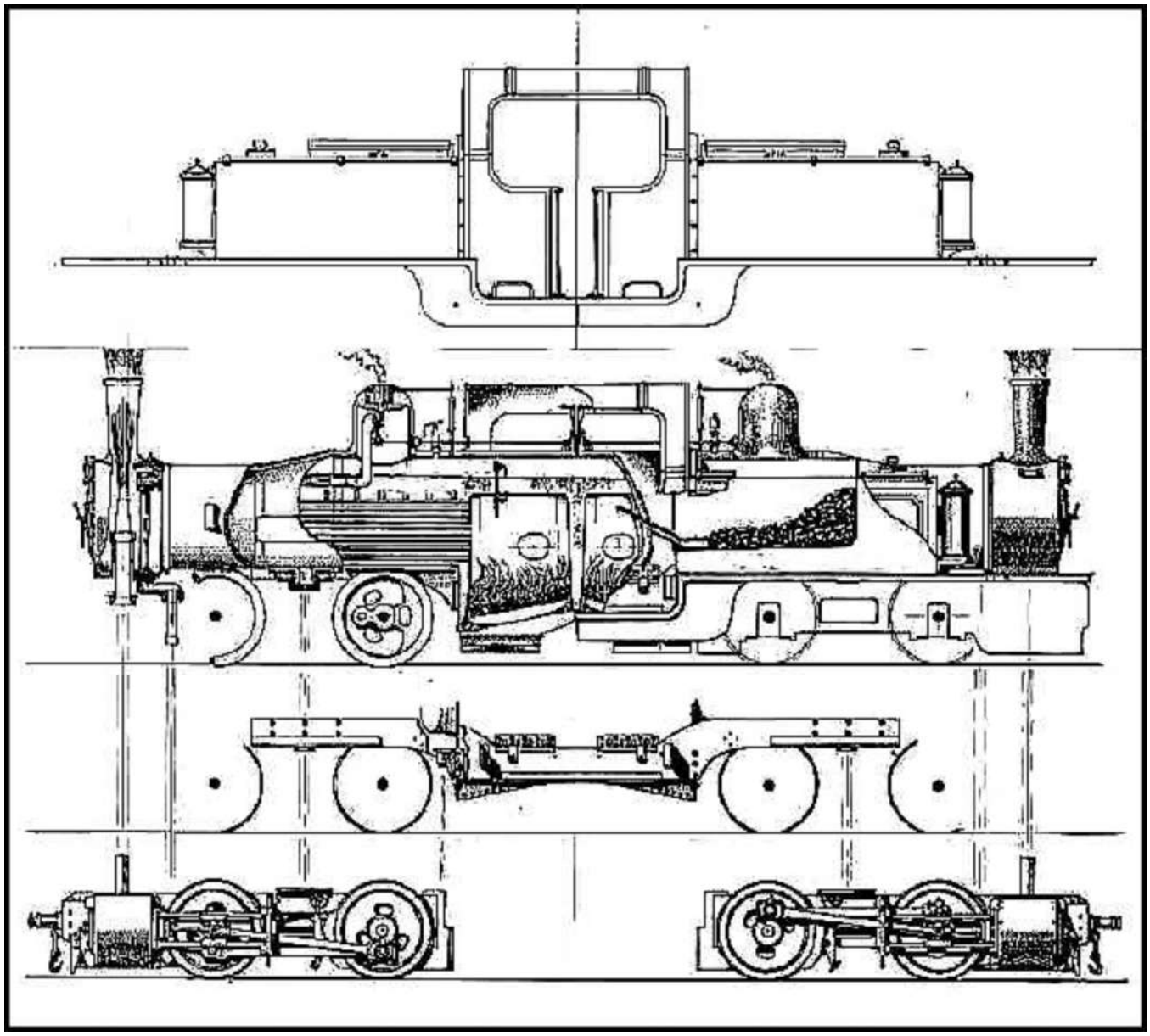
Lantern Tops.

Lantern base & Lens

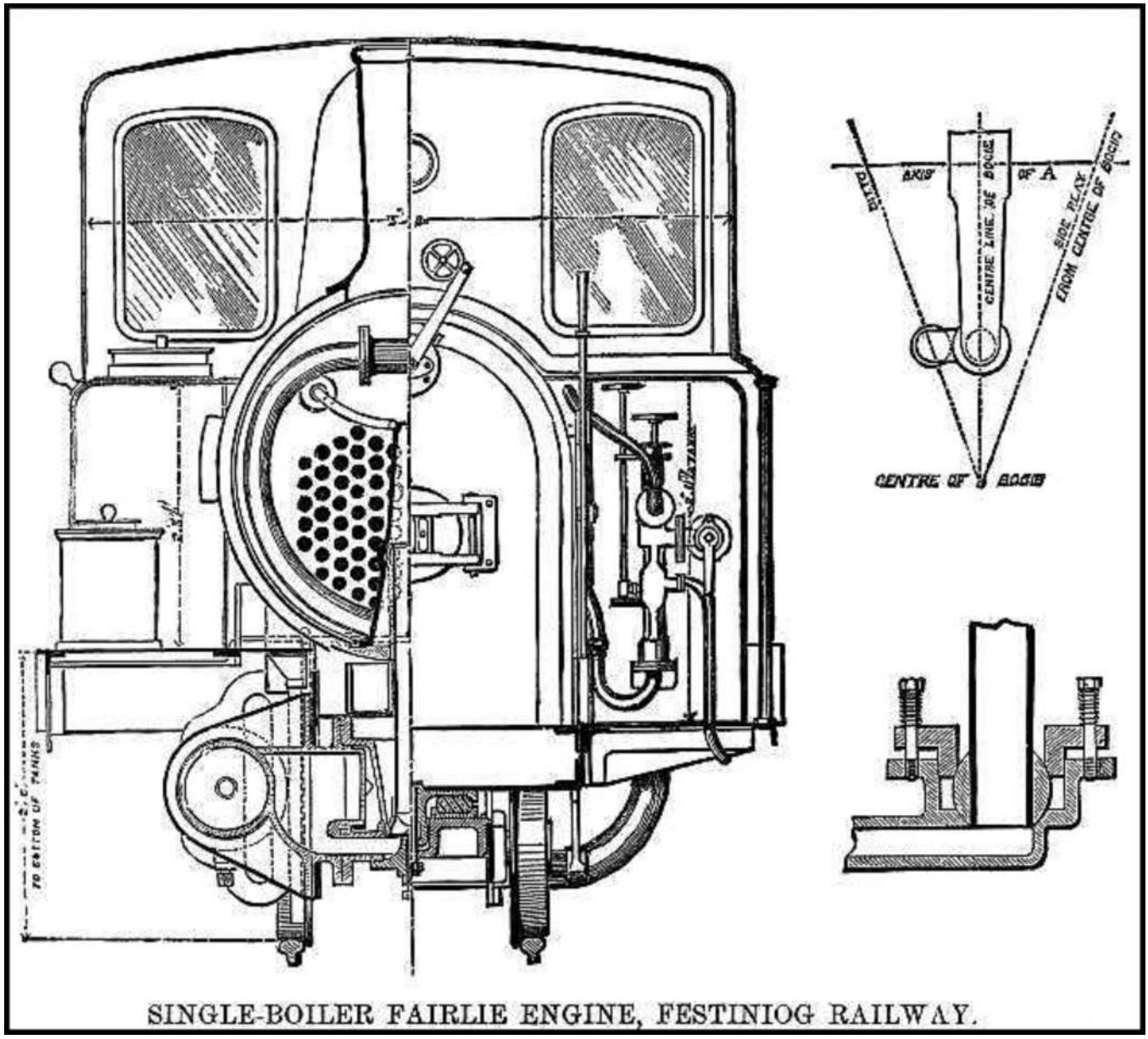


Wheel detail with brake shoe and oiler caps on the drive rod.

The following are a couple of plans that may be of interest.

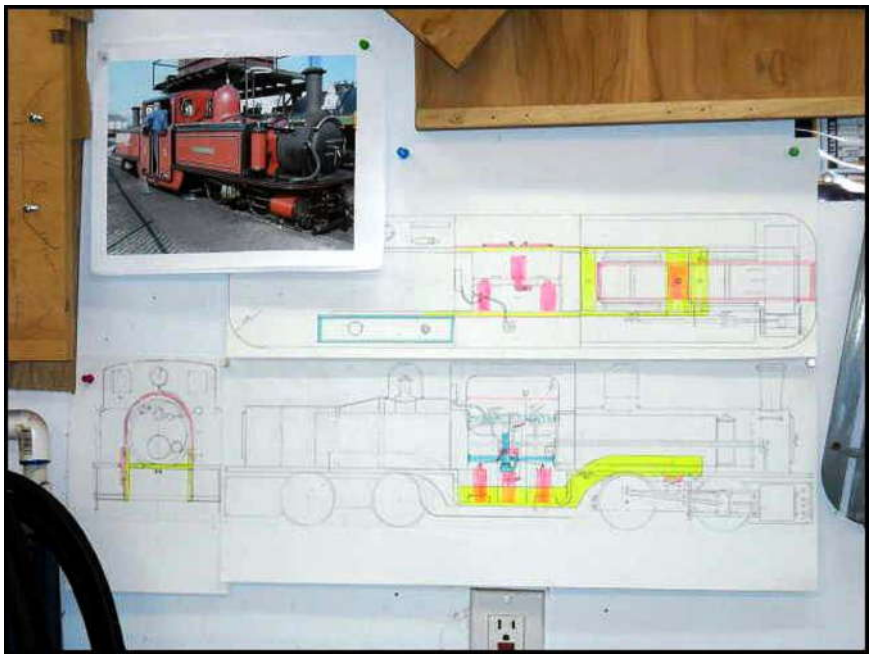


This diagram has no dimensions but shows the construction of the original.



SINGLE-BOILER FAIRLIE ENGINE, FESTINIOG RAILWAY.

Here is a diagram of a Single Fairlie. There are some differences but it was still useful. The one dimension along with the 1'-11 1/2" gauge was helpful.

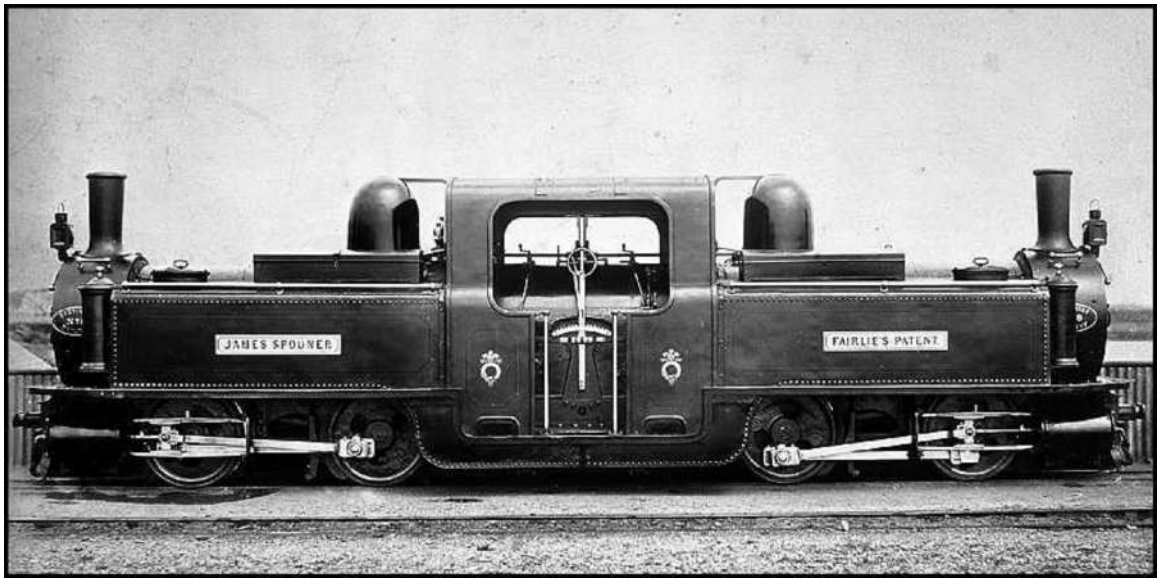


Above is the full size drawing I used tacked to my workshop wall you can see the photo of a Double Fairlie at the top. Every time I made a part, I would check it with the calipers to the drawing. You can see that I only showed some detail on one side or the other to keep the drawing from getting too busy. Many of the detail parts and engine valving design was done by my friend Dennis. He also copied some of my designed pieces to CAD for future use.

Tony Willmore, Rhos Helyg Locomotive Works, UK

"Very nice, and a neat solution to the one boiler/two boilers problem."

"Just one thing... the Johnson Bar (or Reverser as we call it in the UK) has a double ended quadrant on these locos; otherwise they would only be able to work in one direction. Mid-gear is with the lever vertical, and the lever is moved one way or the other to select the direction of movement."



Tony thanks for the photo. It is the first one I have seen that shows the Johnson bar detail. The Model I copied had a slightly different ratchet setup and the shot was at an angle, which hid one of the notched sides. I thought straight up would be one direction and down the other. It should be easy to modify. I also noticed it looks like the earlier models didn't have the raised "wagon top" boiler. I'll post the revised Johnson bar when it is finished.

> *Tony Willmore, Rhos Helyg Locomotive Works, UK*
> *"The only wagon top boiler still in existence is the one carried by Livingston Thompson (formerly Earl of Merioneth), which is on display at the National Railway Museum in York, and it was last steamed in the early 1970s. None of the operational Fairlies have wagon top boilers, with Merddin Emrys and the 1979-built Earl of Merioneth having almost identical true parallel boilers and David Lloyd George (built 1992) has a half taper (section nearest to cab) and half parallel (section nearest to smoke box) boiler."*
> *"Taper is not the same as wagon top. A taper boiler has sections that are perfectly circular at each end, although of differing diameters. A wagon top boiler has sections that would be circular but are "squashed" in the middle to make them taller, resulting in a flatter area on the boiler sides."*
> *"A picture of the 1979 Earl of Merioneth's parallel boiler can be seen here:"*
> http://www.roger-dimmick.fotopic.ne...95097.html
> *"A picture of the earlier Earl of Merioneth's (now Livingstone Thompson - yes, I know, it is complicated) wagon top boiler is here:"* http://www.ronfisher.fotopic.net/p39148661.html
> *"David Lloyd George and Merddin Emrys appear to have wagon top boiler simply due to the shape of the cladding sheets."*

The following image is also a link to a YouTube video of the Double Fairlie in action.

The Fairlie has been updated since the last posting. Decals and nameplates have been added and the Johnson bar has changed. I have two chuffers (i.e. one in each smoke box) which accounts for all of the weird sounds. As you see it sounds great at low speed but gets a little high pitched at faster speeds. I still have two cars to finish and add. I will evaluate the chuffers with a full load then.

The whistles are over-blowing a little but I have adjusters on them, which I will tweak. I think only the high pitched one was blown in this video. I was taking the video and Dennis was running it.

Sorry about the jumping up and down but at least I didn't forget to stop it and take a video of my feet like I usually do.